

Application No. 09/996,951

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Remarks

Claims 21-26 remain in this application. Claims 1-20 have been cancelled. Claims 21-26 have been added.

In an Office action dated January 24, 2003, claims 1-5 and 7 were rejected under 35 U.S.C. 102(a) as being anticipated by Bottom, while claims 6 and 8 were rejected under 35 U.S.C. 103(a) as being obvious in view of Bottom. The remaining claims were rejected under 35 U.S.C. 103(a) as being unpatentable over Ella, Krishnaswamy et al. or Ylilammi in view of Bottom. In order to more clearly distinguish Applicants' claimed invention from the cited prior art, the original set of claims has been cancelled and claims 21-26 have been added. The pending claims describe the method as including the step of fabricating acoustic resonators on the basis of achieving an intended operational resonant frequency. If the current resonant frequencies of the fabricated acoustic resonators are outside of an acceptable margin of error with respect to the intended operational resonant frequency, the resonator is exposed to a controlled gaseous environment in which at least one electrode layer of the resonator is oxidized, with the gaseous environment being intentionally regulated on the basis of providing the resonator with a final operational resonant frequency within the margin of error. Of the four cited prior art patents, only Bottom was cited for teaching oxidation in order to set the resonant frequency. However, as will be described in greater detail below, Bottom teaches that a resonator is to be fabricated so that its frequency is above the intended operational resonant frequency (Bottom: Abstract) and teaches that anodic oxidation is to be used, since oxidization within a gaseous environment is problematic, at best (Bottom: column 2, lines 1-12).

In view of the distinguishing features contained in claims 21-26, Applicants respectfully submit that the claims are in an allowable condition.

A. Patentability of the Pending Claims under Section 102(a)

To briefly state the standard, a pending claim is anticipated when a single prior art reference discloses all of the material elements of the claim. Of the four cited references, only Bottom describes oxidation in order to vary frequency, so that only Bottom is relevant to the determination of patentability under Section 102.

A first material difference between independent claim 21 and the teachings of Bottom relates to the fabrication of the resonators. As described in claim 21, the claimed method includes fabricating the acoustic resonators on the basis of achieving an intended operational resonant frequency, with the oxidation occurring for those acoustic resonators that are outside of the acceptable margin of error relative to the intended operational resonant frequency. In contrast, the Abstract of Bottom states that the prior art method comprises intentionally forming a resonator so that its frequency is above the nominal operational resonant frequency. After the Bottom resonator is formed to have a frequency above its operational resonant frequency, anodic oxidation is used to reduce the frequency. In fact, Bottom teaches that for occurrences in which the initial fabrication frequency is not sufficiently above the operational frequency, etching techniques are to be used to increase the frequency, whereafter the anodic oxidation reduces the frequency (Bottom: column 5, lines 61-68). Since Bottom does not anticipate fabricating resonators on the basis of achieving an intended final operational resonant frequency, the prior art reference does not anticipate claim 21 or its dependent claims.

A second material difference between the teachings of Bottom and the method described in claim 21 relates to the step of exposing acoustic resonators to a controlled gaseous environment, with the gaseous environment being regulated on the basis of providing the final operational resonant frequency. In contrast to the claimed invention, Bottom repeatedly states that anodic oxidation is to be employed. Anodic oxidation is illustrated in Fig. 2 of Bottom and is described in the portion of the patent that begins on line 47 in column 4. A pair of leads (14 and 14A) connects a power supply (20) to the crystal unit to which oxidation is to be applied. The crystal unit is suspended in a tank (22) filled with a fluid electrolyte (24) that contains oxygen-bearing anions. Also positioned in the electrolyte is an aluminum cathode (26), which is connected to the negative side of the power supply. The voltage from the power supply is adjusted "so that it will cause an oxide layer of the desired thickness to be produced on the two aluminum contacts of the crystal unit." The patent identifies a number of solutions that may be used as the electrolyte. Since the prior art reference to Bottom teaches oxidation within a solution, the patent does not anticipate a step of exposing acoustic resonators to a controlled gaseous environment that is regulated on the basis of providing each acoustic resonator with a final operational resonant frequency within a margin of error of an intended frequency.

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Since there are at least two material differences between the pending claims and the teachings of Bottom, Applicants respectfully submit that claims 21-26 are not anticipated by the teachings of Bottom.

**B. Patentability of the Pending Claims under Section 103(a)**

The rejection of the original claims under 35 U.S.C. 103(a) was based upon a combination of Bottom with any one of Ella, Krishnaswamy et al. or Ylilammi. Applicants respectfully submit that the modification of any of the three patents in view of the teachings of Bottom would not render the method of claim 21 obvious under Section 103(a).

It is stated in the Office action that none of the three references to Ella, Krishnaswamy et al. or Ylilammi explicitly teaches how to achieve a final frequency adjustment. Applicants agree that neither Ella nor Krishnaswamy et al. describes adjusting the frequency of resonators. However, it is respectfully pointed out that Ylilammi teaches a method of tuning a thin film Bulk Acoustic Wave Resonator (FBAR) so as to minimize a disparity between an exhibited resonant frequency and a reference frequency. In the Abstract of the patent, Ylilammi teaches that the prior art method includes measuring the frequency at which the FBAR exhibits either its series resonance or its parallel resonance. In the next step, an "amount A" is calculated. The calculated amount A is the layer thickness that needs to be altered in order to minimize the difference between the measured frequency and the reference frequency. In the final step, the thickness of the layer is altered by the calculated amount A. In column 2, lines 27-33 of the patent, it is stated that this step of altering the thickness is preferably performed by removing material from a layer, since the addition of a layer may cause a short circuit within the FBAR. However, a detailed description of adding material in order to adjust the frequency is provided starting in column 8 of the patent. As described, the preferred additional material is either a vacuum deposition of the same material used to form the electrodes or a deposition of the same material used to form the piezoelectric layer, such as zinc oxide.

Applicants respectfully point out that even if one were to impermissibly use the aid of hindsight and were to modify the teachings of Ylilammi to include the oxidation described in Bottom, the resulting method would not render pending claims 21-26 obvious under Section 103(a). As previously described, Bottom teaches anodic deposition in an electrolytic solution. The anodic deposition is shown in Fig. 2 of Bottom. The anodic

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deposition is inconsistent with Applicants' claimed method, which includes a step of exposing acoustic resonators to a controlled gaseous environment, which is intentionally regulated to achieve a final operational resonant frequency. Since the combination of Yllammi and Bottom does not teach (or suggest) the method of claims 21-26, it is submitted that the claims are allowable over the two prior art references. Moreover, because neither Ella nor Krishnaswamy et al. describes the adjustment of frequencies, the collection of patents does not render the claimed invention obvious.

In fact, Bottom teaches directly away from modifying any one of Yllammi, Ella and Krishnaswamy et al. to more closely approach the invention described in the pending claims, particularly claim 26. Lines 1-3 in column 2 of Bottom state that heat treatment in air at temperatures below 300°C to stabilize the frequency is "useless" and "too time consuming." Consequently, the person of ordinary skill in the art would not find it obvious to modify one of the three other cited patents to include a step of exposing resonators to a controlled gaseous environment, as set forth in the pending claim 21. Even more on point, the teaching in Bottom that frequency stabilization in air at temperatures below 300°C is "useless" does not render it obvious to provide frequency adjustment in a gaseous environment in which the temperature does not exceed 215°C.

Moreover, Bottom teaches that oxide films produced by heat treatment in air are rough and non-uniform (Bottom: column 2, lines 7-12). Again, this leads a person of ordinary skill in the art away from modifying any one of the patents to Yllammi, Ella and Krishnaswamy et al. to approach Applicants' claimed invention. Bottom then teaches that the prior approach to adjusting the frequency of crystal resonators was to plate the aluminum contacts with silver (Bottom: column 2, lines 13-15). This is consistent with the approach described in Yllammi, but inconsistent with Applicants' claimed approach. It is submitted that none of the Bottom teachings regarding resonator modifications renders Applicants' pending claims obvious, even when combined with the teachings of one or more of the remaining patents.

Attached hereto is a complete listing of the claims in this patent application. The status of each claim is indicated, in accordance with the proposed revision to 37 CFR 1.121 (Manner of Making Amendments).

Applicants respectfully request reconsideration of the claims in view of the amendments and remarks made herein. A notice of allowance is earnestly solicited. In the case that any issues regarding this application can

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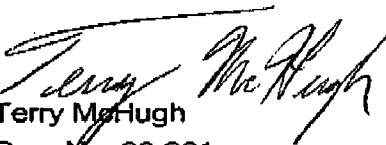
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be resolved expeditiously via a telephone conversation, Applicants invite the Examiner to call Terry McHugh at (650) 969-8458.

Respectfully submitted,

  
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